

Title: Pattern Explosion

Brief Overview:

This unit includes various tasks that take students through a hierarchy of patterns. Included are teacher and student resources on the hierarchy of patterns, problem solving, and strategies to develop a rich math vocabulary. Students will be able to copy, recognize, describe and create patterns, as well as use a function table to identify the relationships in patterns and numbers. This unit will follow a sequence that will allow students to use knowledge and resources to complete new tasks. It will also allow teachers to use the tasks to assess students' needs and to develop students' knowledge.

Links to NCTM 2000 Standards:

- **Standard 2: Patterns, Functions, and Algebra**
Mathematics instructional programs should include attention to patterns, functions, symbols, and models so that all students understand various types of patterns and functional relationships; and use symbolic forms to represent and analyze mathematical situations and structures.
- **Standard 6: Mathematics as Problem Solving**
Mathematics instructional programs should focus on solving problems as part of understanding mathematics so that all students build new mathematical knowledge through their work with problems; apply a wide variety of strategies to solve problems and adapt the strategies to new situations; and monitor and reflect on their mathematical thinking in solving problems. Students will demonstrate their ability to solve problems in math by using their knowledge of patterns. Problem solving will emphasize the use of manipulatives, cooperative learning, diagrams, and recognition of patterns in their environment.
- **Standard 7: Mathematics as Reasoning**
Mathematics instructional programs should focus on learning to reason and construct proofs as part of understanding mathematics so that all students recognize reasoning and proof as essential and powerful parts of mathematics; develop and evaluate mathematical arguments and proofs; and select and use various types of reasoning and methods of proof as appropriate. In this unit, students will copy, identify, describe, and create patterns. They also will explain patterns by identifying the core of the patterns.
- **Standard 8: Mathematics as Communication**
Mathematics instructional programs should focus on learning to reason and construct proofs as part of understanding mathematics so that all students organize and consolidate their mathematical thinking to communicate with others; express mathematical ideas coherently and clearly to peers, teachers, and others; and use the language of mathematics as a precise means of mathematical expression.

Students will use math vocabulary in their communication with teacher and other students. They also will read word problems, communicate in oral and written language, as well as symbols, manipulatives, and diagrams.

- **Standard 9: Connections**

Mathematics instructional programs should emphasize connections to foster an understanding of mathematics so that all students understand how mathematical ideas build on one another to produce a coherent whole; and recognize, use, and learn about mathematics in contexts outside mathematics. Students will demonstrate their ability to connect patterns to real life problems, i.e., word problems.

- **Standard 10: Representation**

Mathematics instructional programs should emphasize mathematical representations and foster an understanding of mathematics so that all students create and use representations to organize, record, and communicate mathematical ideas; and use representations to model and interpret physical, social, and mathematical phenomena. Students will be able to represent and record patterns using function tables, concrete materials, and manipulatives.

Grade/Level:

Grades 3-4 (May be used for students with special needs.)

Duration:

Approximately 6 class days

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Experience with pattern blocks
- Knowledge of basic mathematical operations (addition, subtraction, and multiplication)

Student Outcomes:

Students will be able to:

- copy a given pattern.
- identify the core of a given pattern.
- continue a given pattern.
- build a pattern when given a description.
- use attributes of patterns to select/distinguish patterns from other pictures.
- make predictions about a pattern.

- organize information in a function table to identify the relationship between patterns.
- understand and use vocabulary.

Materials/Resources/ Printed Materials:

- Pattern blocks
- Overhead pattern blocks
- Pattern block stickers
- Sentence strips with patterns on them
- Pencils
- Teacher Resource Sheets #1-6
- Motion cards (clap, snap, stomp)-5 of each- (Use words if pictures are not available.)
- File folders* optional
- Large cut-outs of pattern blocks
- Teacher Charts
 - Chart A - Hierarchy of Patterns
 - Chart B - Math Talk
 - Chart C - Problem Solving Strategies
 - Chart D - Problem Solving Model

Development/Procedures:

Day 1 (Copy & Continue)

Teacher starts a rhythmic pattern (clap, clap, snap, snap) and asks students to join in.

Then select three motion (words-if pictures are not available) cards and do the pattern, having students join in after they have heard/seen the pattern twice.

Allow students an opportunity to develop their own rhythmic patterns and share them with the class. (Students may use motion cards if they cannot develop their own pattern.)

Using large cutouts of pattern blocks, make a pattern on the board. Introduce the word, “pattern”, and write it on the math talk chart. (Chart B) Explain and show how patterns repeat.

Using the same pattern blocks, put a core or a pattern on the board. Introduce the word core and write it on the math talk chart. (Chart B) Explain that a core is the part of the pattern that will repeat and that it will form a sequence. Write the word sequence on the board, and add vocabulary to the chart as new vocabulary is introduced or used. Teacher should then call students up to the board and practice repeating the core.

Have students look around the room to find other patterns. (Provide some examples in case students have difficulty, i.e., checker board, ceiling tiles, etc.)

Have students make a list of patterns that they see on their way home, in their yard, and inside their home.

Day 2 (Copy, Describe, Build w/description, Create)

Using overhead pattern blocks, show the students a pattern. Have them copy it at their desks using the pattern blocks. Have the students find the core in the sequence. Move from using colors to describe the sequence to having them use ABAB. Then repeat the pattern for three more terms. Write the word term on the math talk chart and explain that term is each individual place in the sequence. Then repeat the pattern for three more terms. Write the word term on the math talk chart.

Create a pattern on the overhead but do not let the students see it. Give the students clues about the pattern one-by-one using vocabulary from the math talk chart.

(Example - See Teacher Resource #1 for sample questions.) Have the students try to guess your pattern and copy it using the clues given. Repeat until teacher feels that the students have an understanding of vocabulary and pattern sequencing.

Group the students in pairs. Have students sit back to back or place a file folder between them for a barrier. One student will create and describe their pattern (using math vocabulary) while their partner tries to create the pattern being described. Continue this activity until each student shares, creates, and describes at least two patterns.

Using overhead pattern blocks, place two rows of blocks on the overhead. One row should be a pattern and the other should not. Using the information the students have learned about patterns, have them figure out which sequence is a pattern and which one isn't. The students need to be able to explain their reasoning. (Example: This is a pattern because it has a core. This isn't a pattern because it does not repeat.)

Day 3 (Performance Assessment on First 5 Steps of the Hierarchy)

Teacher should set up three stations around the room. (Example: Use Chart A as a reference for steps.) Station set-up directions will follow.

Divide the class into three groups.

Teacher will walk around and observe students at different stations and will use a checklist. (Teacher Resource #2) Students will receive a check mark or smiley face if they completed the task and will receive an X or unhappy face if the task was not completed. Teacher may use any variation.

Station Set-Up

#1- Copy & Continue Station

Have several pattern strips on the table and a box of pattern blocks or stickers and paper. Explain that students will need to copy the pattern on the paper and continue the pattern for 3 terms.

#2- Describe

Have pattern strips on the table along with blank paper. Students will write a brief description of the pattern using correct math vocabulary. (They will need to identify the core.)

#3- Build/Describe and Create

Have several pattern strips and a box of pattern blocks or stickers on the table along with blank paper or unused sentence strips. Students are to take turns picking out a pattern and describing it to the other students in the group. The student describing the pattern should be using the correct vocabulary and the student(s) listening to the description should be creating the pattern using the blocks and or stickers on the blank strips of paper.

Day 4 (See and Make Predictions)

Place different patterns on the overhead and review vocabulary.

Using overhead blocks, create a flower on the overhead where it can be seen by the class. (Flower is made with one green and three blue pattern blocks – see Teacher Resource #3 for patterns and pictures to be used for this lesson.)

Have students duplicate this pattern on their desk with their pattern blocks.

Write the number sentence (1) One flower = (3) three petals. Make a second flower. Have students copy and write (2) Two flowers = (6) six petals. Finally, make one more flower and write (3) flowers = (9) petals.

Then ask the question: How many petals would you have with four flowers? Give students time to use manipulatives to solve the problem and share their strategies for finding the answer with their classmates. At this time refer to Problem Solving - Chart C and discuss different ways to problem-solve. (Such as drawing a picture of the problem, look for a pattern in the data, making a table, trial and error, and working a simpler problem.) Teacher may also display and refer to Problem Solving Model - Chart D.

Have students determine the number of petals there would be on 20 flowers. Give students time to solve and share their strategies.

Introduce a function table and write it on the Math Talk Chart. Explain that the function table is a way to solve problems. Discuss input, output and relationship and write them on the Math Talk Chart. Explain that the chart will help find a relationship between the input/flower and output/petals. (See Teacher Resource #5a).

Repeat using patterns and number sentences. (Use Teacher Resource #3 for other patterns.) Example - one boat has two sails, and so forth. Make sure you give students plenty of time to decide on their strategy and solve the problem. Then ask them how many sails do 15 boats have? Give them the hint that this is the time to use the function table. Note - If the students get the wrong answer do not tell them that they are wrong but have them explain how they got their answer and see if they find their error. If not, demonstrate the correct steps. (See Teacher Resource #5b).

Create a bridge pattern on the overhead with the overhead pattern blocks. Write the statement: One span has two posts. Connect a second bridge, and write: two spans have 3 posts. Have students find out how many posts will be needed for 10 spans; then for 50 spans. Give students time to solve problems and to share their different strategies.

Day 5 (Organize information and Find Regularity - with Word Problems)

Introduce word problems (Teacher Resource #4)

Write a word problem on the board or overhead. (Have another student read the problem for those with difficulty reading.) Have students solve the problems but do not give them any further instructions.

*Note - Walk around and observe their work. Do not help students at this point. Make comments like, “How else can you solve this?” or “Look at it another way”.

Have students share their solutions and strategies.

Write another word problem on the board and repeat the preceding steps. After the students have shared their strategies, if no one has used a function table, demonstrate for them how to use the function table to solve the problem - Teacher Resource #5.

Write another word problem on the board and have students use a function table to solve the problem. After they have found the answer, they will need to write a brief explanation on how they solved the problem.

Performance Assessment (Day 6):

- Discuss Assessment Writing Rubric (Teacher Resource #6). Explain what will be expected of them and how they will receive points.

- Write the following word problem on the board. Give each student paper and a pencil. (Have students read the problem and raise their hand if they do not understand so that it can be read and explained to them.)
Bob is having a party. He wants to have an egg toss. He will need 1 egg for every 2 friends that he invites. If Bob invites 68 friends, how many eggs will he need? If Bob has only 24 eggs how many friends can he invite?
- Have students solve problem (individually) and score according to rubric.

Extension/Follow Up:

- Have students create their own word problems.
- Have students solve word problems with a function table and equations, e.g., $(20 = n + 5)$.

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Hierarchy of Patterns

- 1. Copy**
- 2. Continue**
- 3. Describe**
- 4. Build a pattern when given a description**
- 5. Create**
- 6. See patterns and make predictions**
- 7. Organize information and find regularity in the data**

Math Talk

Term

Core

Relationship

Sequence

Pattern



Problem Solving Strategies

- **Work Backwards**
- **Make an Organized List**
- **Guess and Check (Trial and Error)**
- **Look for Patterns**
- **Build a Model**
- **Draw a Picture or Diagram**
- **Brainstorm**
- **Work a Simpler Problem**
- **Use Logical Reasoning**
- **Make a Table**

PROBLEM SOLVING MODEL

UNDERSTAND	the problem
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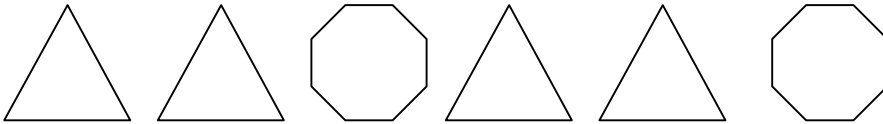
SELECT	the strategy
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SOLVE	the problem
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CHECK	the solution
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SAMPLE CLUES

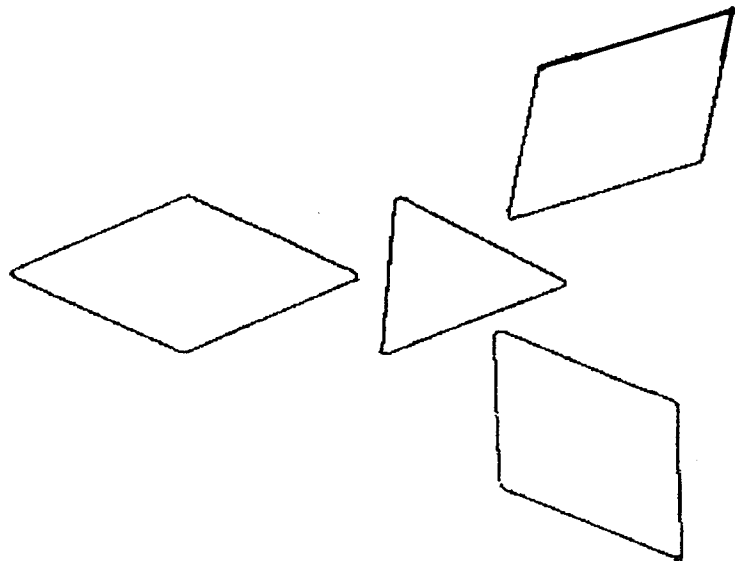
- 1. The first term in the core is a triangle.**
- 2. The core consists of only 2 shapes.**
- 3. There are 3 terms in the core.**
- 4. One hexagon always follows 2 triangles.**



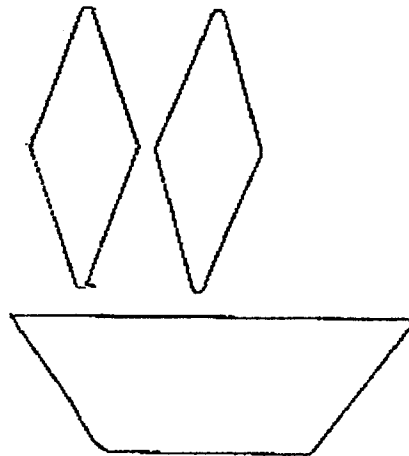
Assessment Checklist

	Task was completed	Task wasn't completed
1. Copy Pattern		
2. Continue Pattern		
3. Describe Pattern		
4. Build Pattern from Description		
5. Create a Pattern		

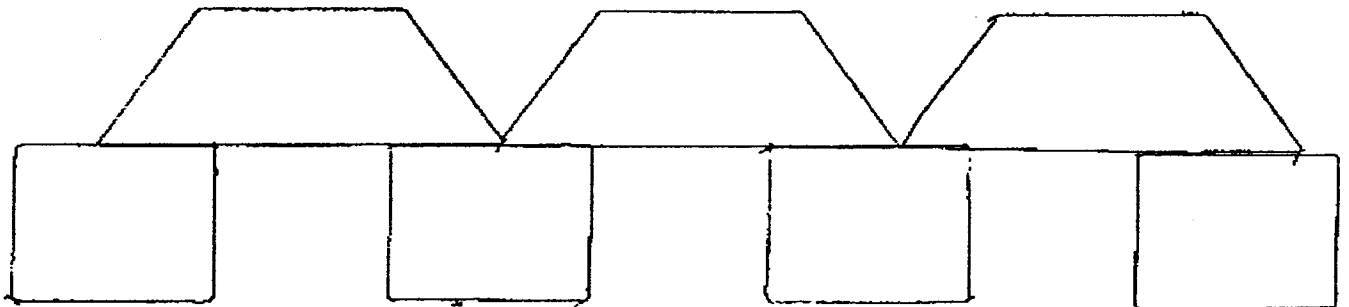
Flower



Boat



Bridge



Sample Word Problems

- 1. Susan wants to plant groups of flowers in her garden. She wants 3 daisies and 2 petunias in each group. If she wants 16 groups of flowers, how many daisies will she need? How many petunias will she need?**

- 2. Three people can stand under one umbrella and not get wet. If there are 27 umbrellas, how many people will not get wet?**

- 3. Tom is having some friends over to play cards. He has 5 tables. Each table will seat 4 people. How many people can he invite? If he wants to invite 65 people, how many tables will he need?**

- 4. On Field Day, everyone was given a bag lunch consisting of 1 sandwich, 1 drink and 3 cookies. If they made 17 lunches, how many cookies would they need? If they had 174 cookies, how many lunches could they make?**

Function Table

5a

Input	Output

5b

Flowers	Petals
1	3
2	6
3	9
20	?(60)

1 Flower = 3 Petals**2 Flowers = 6 Petals**

Rubric for Final Lesson

- | | |
|---|---|
| 3 | Student used vocabulary.
A chart was made.
Solution was explained. |
| 2 | Student used vocabulary.
A chart was made.
Solution was partially explained. |
| 1 | Student used some vocabulary.
Chart was not made.
Solution was not explained. |
| 0 | No vocabulary was used.
Chart was not made.
Solution was not explained. |